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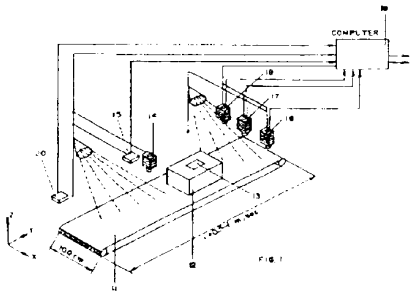
(54) Parcel sorting system.

(57) A system for the sorting of parcels as they move on a conveyor in a sorting establishment of a Post Office or of a parcel delivery company. The system is capable of locating the label on the parcel bearing data of the adressee, and establish its dimensions. The coordinates of the label are determined by a low magnification camera, and scanning cameras are used for a sharp line scan of the data on the label, means being provided for desplaying the data and for ultimately sorting the parcels according to the said data.

There is also provided a method for sorting parcels moving on a conveyor belt by acquiring the data on the relevant label and using the data for the sorting of the parcels according to their destination.



EP 0 647 479 A2

FIELD OF THE INVENTION

The invention relates to a system and method for automatic detection and high resolution display of parcel labels scanned from a moving conveyor belt. It is primarily suited for automatic parcel sorting in depots. The system, working at high speed, automatically detects the relevant parcel label, by means of a two stage inspection technique, from a large scope of label colors, contrasts, sizes and positions. In addition, the system automatically measures the length, width, and height of the parcel. The system of the invention can be interfaced to a commercially available optical character recognition (OCR) system and/or bar code decoders (when the parcel has a bar code label). This parcel information can be transmitted to the sorting machine or to the depot database for follow up.

The system can deliver the high resolution image of the label to an operator for manual keying of the parcel label as remote video encoding (RVE) that will increase the speed and reliability of the sorting process.

BACKGROUND OF THE INVENTION

Depot parcel sorting is generally done manually by the depot employees. By automating the process, one can reduce the number of employees in the depot as well as increase speed and reliability.

In the late 80's, optical character recognition systems were introduced to read the zip code on evelopes in major post office facilities.

The problem of reading the label on parcels has not been satisfactorily solved due to the fact that the parcel size can vary in a relatively large range, and the label position can be arbitrary, therefore, there is a problem imaging labels with a high resolution of up to 400 DPI that is required for OCR. Moreover, the label color and contrast is in a wide range.

SUMMARY OF THE INVENTION

The invention relates to a system and to a method for the location of a relevant label on a package while this is moving on a conveyor. The invention further relates to a system and method for determining the dimensions of such a parcel. The main feature of the novel system and method is the ability to determine the location of the relevant label (which bears the address of the receiver of the parcel) and to focus on same so that its image can be projected to a desired location. In the presence of more than one label on the upper surface of the parcel, the system either recognizes which of these is the relevant one, or if this is not within the capability of the system, it projects the images of the labels which may be relevant to the desired location, where these images can be scanned and evaluated.

The image is one of high resolution, enabling to discern all required details and data on such label.

Furthermore, the system of the invention makes it possible to project a sharp image of the relevant label, even if this is colored and even if the lettering is also colored.

Thus the invention relates to a system for locating a relevant label bearing the data of the addressee on a parcel and its high resolution display, while this moves on a conveyor belt, and for optionally determining the dimensions of such parcel, which comprises:

means for determining the height of the upper surface of the parcel above the conveyor band;

a color frame grabber adapted to acquire a picture from the color CCD camera, means for determining the coordinates of the label on the surface of the parcel;

means for actuating the picture acquisition as a function of the distance of the label from the front edge of the parcel and the velocity of movement on the conveyor;

a camera and means for focusing such camera to the plane corresponding to the height of the parcel;

means for distinguishing between a label bearing the data of the addressee and labels bearing other indications.

An alternative system is one where the surface of the moving conveyor band is scanned by means of a scanning mirror, picture acquisition of the relevant label being actuated when required according to the determination of label position on the moving parcel. Advantageously, the height of the parcel is determined by means of an ultrasonic sensor. A preferred system comprises a CCD camera for label coordinate detection, an acoustic sensor for height determination and a high resolution line scan camera enabling a high resolution line and high speed scan imaging the area of the relevant label.

A specific system comprises means for acquiring at a short time interval two images of the parcel moving in a linear motion on the conveyor, means for obtaining a subtration image of said images, and means for deducing from said subtraction image the outer edges of the parcel and the location and size of the relevant label, and means for providing a high resolution image of said label.

The invention is illustrated by way of example only with reference to the enclosed schematical drawings and block diagrams, where the drawings are not according to scale, and in which:

Fig. 1 is a diagram of an image acquisition system for acquiring the image of a label on a parcel moving on a conveyor belt;

Fig. 2 is a diagram of an alternative system to that of Fig. 1;

Fig. 3 illustrates the acquisition of a label on a parcel moving on a conveyor belt;

Fig. 4 illustrates a method of obtaining a sharp image of a label;

Fig. 5 is a block diagram illustrating the steps of label location and parcel dimensioning according to the invention.

By automating the process of sorting parcels in depots, one can obtain a follow-up of all parcels in the various depot facilities due to the fact that the label information regarding the specific parcel was read by the OCR system. If the label has a bar code in it, the system can read the information of the label without the need of an employee to laser scan the bar code.

Another option is to use the system to display the high resolution video image to the depot employee for manual keying in of the parcel label. This mode of operation will increase dramatically the sorting capabilities of the depot because the employee will not have to find the label on the big parcel. The big parcel label detecting and display increase the parcel sorting speed and reliability in the depot.

According to a preferred embodiment of the invention, the system is interfaced with a commercially available optical character recognition (OCR) system, which reads the high resolution picture of the label.

In the sorting process the parcel is loaded manually on the conveyor belt with a typical velocity of one meter per second. A proximity sensor such as keyence PZZ-41 signals the system when a parcel enters the imaging zone. The height of the parcels varies, so a height measurement is performed using an ultra sonic height sensor microsonic MIC-100/IU with a one cm accuracy. This measurement enables an automatic focusing of a high magnification lens on camera B. The automatic focus mechanism includes a stepper motor that is connected to the focus disk surrounding the lens.

When the parcel enters the imaging zone (see Figure 1) a color frame grabber acquires a picture from a color video camera such as Sony 151-AP (Camera A) with a low magnification lens that displays the parcel on the conveyor just after the proximity sensor.

The camera has a electronic shutter which enables high speed acquisition to avoid blurring as a result of the conveyor movement. An image processing algorithm detects the labels on the parcel and provides the coordinates X, Y of the label (see Fig. 3) in reference to the fomt edge point. In addition, the algorithm decides in the case of more than one label, which is the relevant label.

With the knowledge of the label location on the parcel and the conveyor velocity, the computer signals the variable scan frame grabber the time and place to grab the high resolution picture. The time when to acquire depends on the label Y coordinate in respect to the parcel front edge and the conveyor velocity which defines the time to pass the Y distance. The variable scan frame grabber is connected to three Fairchild 2000 pixels line scan cameras placed across the conveyor allowing coverage of the full belt (Width Order of 1 meter) and yet achieve high resolution of 400 DPI required by the OCR algorithms. The number of line cameras is dependent on the width of the specific conveyor belt. In the computer memory a full image of the label is contructed line by line as the label passes under the line scan camera.

Another option (see Fig. 2) for achieving the high resolution and large field of view is to use a scanning mirror that will can the entire belt instead of using a few line scan cameras. The X coordinate of the label will define which line scan camera will take the picture or where to scan the mirror in the second option. The enlarged two dimensional image can be stored in the computer memory.

The system of the invention provides the volume measurement of the parcel using the coordinates of the parcel generated by the image processing algorithm and the height measurement of the ultrasonic sensor. There is an option of restoring the color image of the parcel for future claims of parcel damage.

The illumination of camera A is the room illumination, while camera B illumination is provided by a quartz halogen bulb attached to a cylindrical optic, which provides line illumination on the parcel.

The image processing algorithm takes advantage of the conveyor belt movement in a definite direction. Camera A acquires two images (with a slight time delay between acquisitions) of the parcel on the conveyor (see Fig. 5). Substraction of these two images, creates a third image, the subtraction image. This image will have the edges of the parcels and the label. The subtraction image (see Fig. 4) is the input for the algorithm for detecting the parcel location (outer edges detection) and the label location from the inner edges in the subtraction image. This information along with the ultrasonic height measurement of the parcel allows the volume measurement of the parcel. The label position in respect to the parcel's front edge allows the optimal acquisition of camera B.

In the parcel location algorithm, the outer edges of the subtraction image are detected in order to give the parcel location - x,y coordinates

of a mono-color parcel.

The single address label on top of the mono-color parcel is found from the inner edges in the subtraction image. The x,y coordinates of the label can be measured in order to acquire the high resolution image of the label with camera B.

When there is more than one label on the parcel the image processing algorithm finds the relevant label based on size, color, and number of rows written for the address.

The system of Figure 1 comprises of a conveyor belt 11 which moves a parcel 12 with a label 13 on the upper surface of the parcel 12. The parcel 12 is examined after trigger from a proximity sensor 20 by camera 14 which is a color CCD camera with electronic shutter to avoid blurring as the parcel moves on the conveyor. The low magnification image of camera 14 indicates the dimension of the upper surface of parcel 12 and the size and location of the label 13. In ultrasonic height sensor 15 measures the height of the parcel to enable volume measurement of the parcel 12 together with the measurement of the upper surface of the parcel 12 performed by the image of camera 14. The height measurement automatically controls the focus mechanism of cameras 16, 17 and 18. The measurement of the coordinates of the label 13 in respect to the parcel 12 front edge as measured by camera 14 actuates the high resolution line scan cameras 16, 17 and 18 at the right time. The images from cameras 14, 16, 17, and 18 is stored in the computer memory by a color and variable scan frame grabber 19.

The system of Figure 2 comprises the same elements as of the system described by Figure 1 except that instead of three line scan cameras 16, 17 and 18, the high resolution image of the label is acquired by one line scan camera 21, with a rotating mirror scanning mechanism that enables the full coverage of the conveyor belt 11 width. The position of the label measured by camera 14 actuates the scanning mechanism of camera 21.

Figure 3 depicts the image as seen by camera 14 in Figure 1 and 2. The image contains part of the conveyor belt 22 and the parcel 23 with the label 24 on top surface of the parcel 23. The image processing algorithm measures the x,y coordinates of the label 24 edges, in respect to the parcel 23, outer edges. F

Figure 4 describes the method to locate the label on the parcel.

From the subtraction image 25, which includes the image of the outer edges of both the parcel and label, the system detects the outer edges 26, which specify the parcel location 28, in repsect to pre-defined coordinates. In addition the system detects from the subtraction image 25, the inner edges 27, which specify the label location 31, in respect to the parcel.

From the ultrasonic height measurement 30, and the parcel location 28, the parcel dimensions 29, are calculated.

Figure 5 depicts the subtraction image used to locate the parcel and labels. Camera 14 of Figures 1 and 2 acquires two images, with a slight time delay between acquisitions of the parcel on the conveyor 31, 32. The subtraction image 33, of the image 31, 32 contains the outer edges of the parcel and the inner edges of the labels. This image is the input for the algonithm for detecting parcel and label location.

Claims

1. A system for locating a relevant label bearing data of the addressee on a parcel and for its high resolution display, while said parcel moves on a conveyor belt, and for optionally determining the dimensions of such parcel, which comprises the stages of:
   a. determining the coordinates of the outline of the parcel and the outline of the relevant label by means of a low magnification camera and determining the height of the parcel by a suitable sensor;
   b. actuating one or more high resolution scanning cameras according to the determination of the label location and speed of movement on the conveyor so as to provide a sharp line scan of said label, and displaying the image thereof at any desired location.

2. A system according to claim 1, where the surface of the moving conveyor band is scanned by means of a scanning mirror, picture acquisition of the relevant label being actuated when required according to the determination of label position on the moving parcel.

3. A system according to claim 1 or 2, where the height of the parcel is determined by means of an ultrasonic sensor.

4. A system according to any of claims 1 to 3, which comprises a CCD camera for label coordinate detection, an acoustic sensor for height determination and a high resolution camera enabling a high resolution line scan imaging the area of the relevant label.

5. A system according to any of claims 1 to 4, comprising means for acquiring at a short time interval two images of the parcel moving in a linear motion on the conveyor, means for ob-

taining a subtration image of said images, and means for deducing from said subtraction image the outer edges of the parcel and the location and size of the relevant label, and means for providing a high resolution image of said label.

6. A system according to any of claims 1 to 5, interfaced with a OCR system.

7. A system according to any of claims 1 to 6, comprising means for reading a bar code, if present on the parcel.

8. A system according to any of claims 1 to 7, provided with means for remote video encoding.

9. A system for the determination of the location of a relevant label on a parcel moving on a conveyor, for determining parcel dimensions and for forming a sharp image of such label at a desired location, substantially as hereinbefore described and with reference to the Figures.

10. A method for locating a relevant label at the upper surface of a parcel moving on a conveyor and for optionally determining the dimensions of the parcel which comprises determining the level of the said upper surface above the level of the conveyor, focusing a camera on the surface of the parcel, acquiring at the correct moment the image of the said relevant label and scanning the label, resulting in a high resolution image of the label, and evaluating the data on said label.

11. A method according to claim 10, which comprises scanning the surface of the parcel by a moving mirror, and projecting the image of the label at the correct instant to suitable display means.

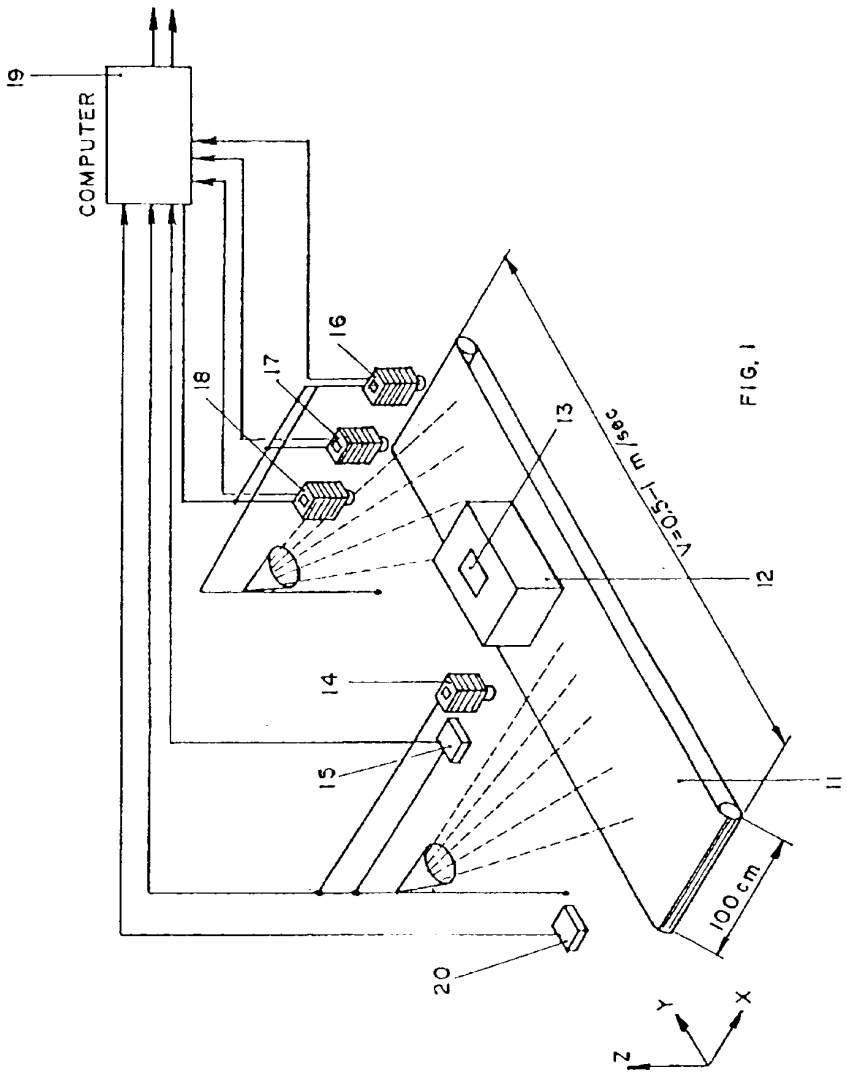


FIG. 1

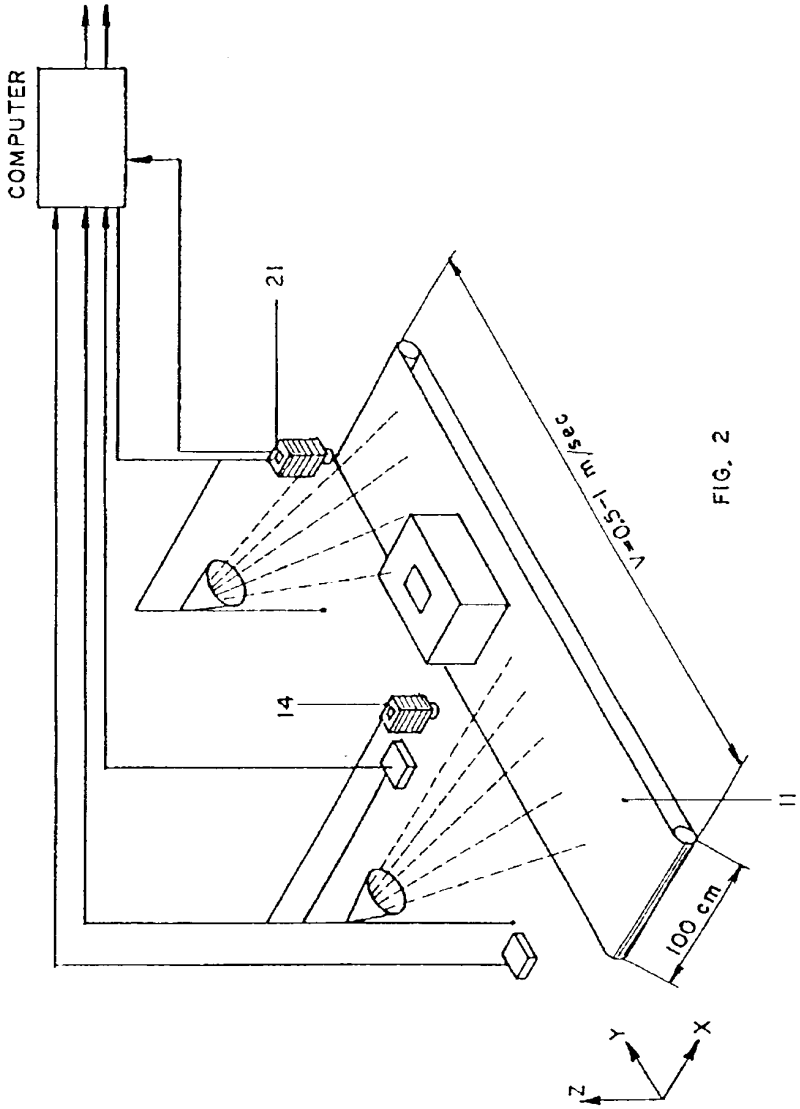


FIG. 2

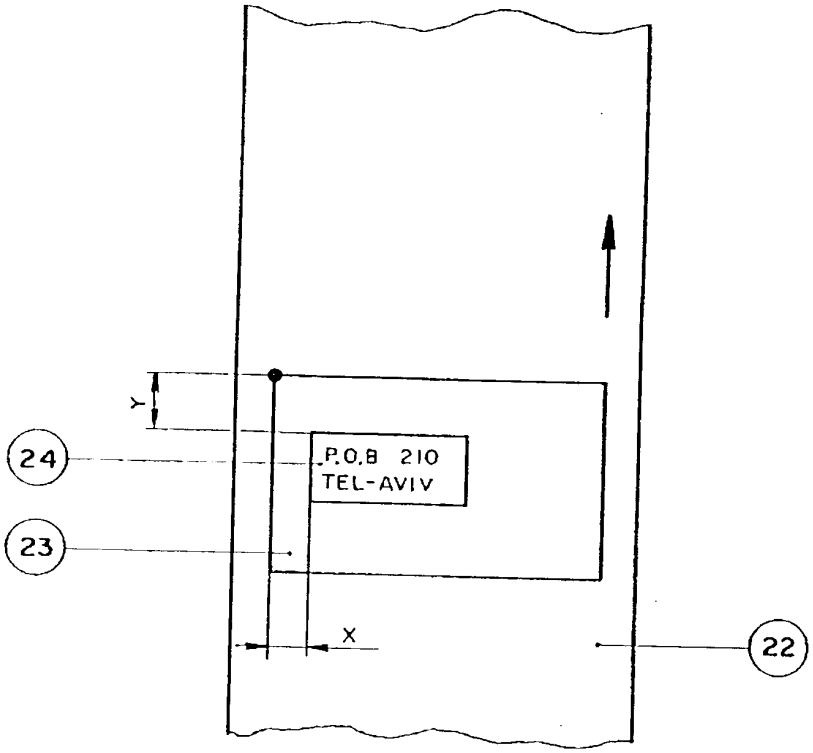


FIG. 3

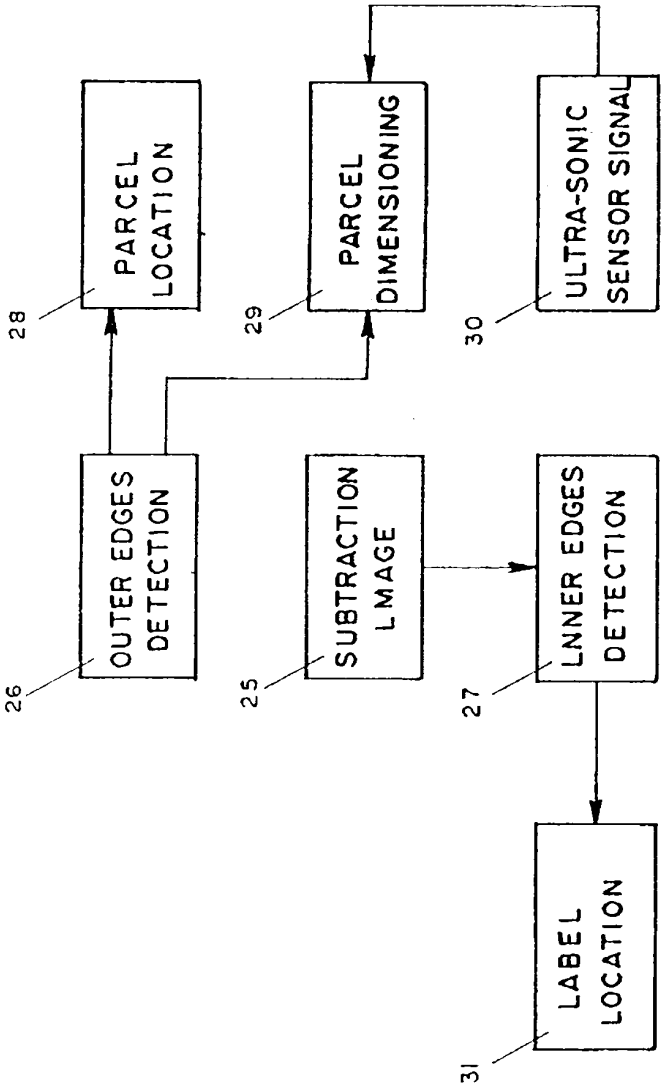

PARCEL LOCATION
28
PARCEL DIMENSIONING
29
ULTRA-SONIC SENSOR SIGNAL
30
OUTER EDGES DETECTION
26
SUBTRACTION LMAGE
25
LNNER EDGES DETECTION
27
LABEL LOCATION
31

FIG. 4

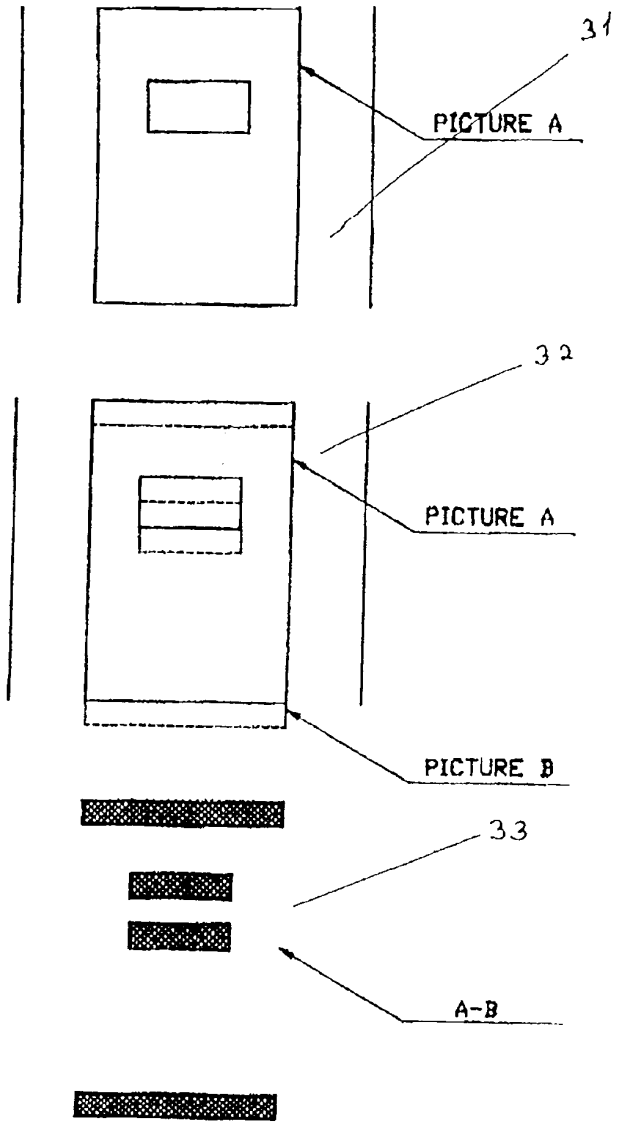


FIGURE 5